HCST

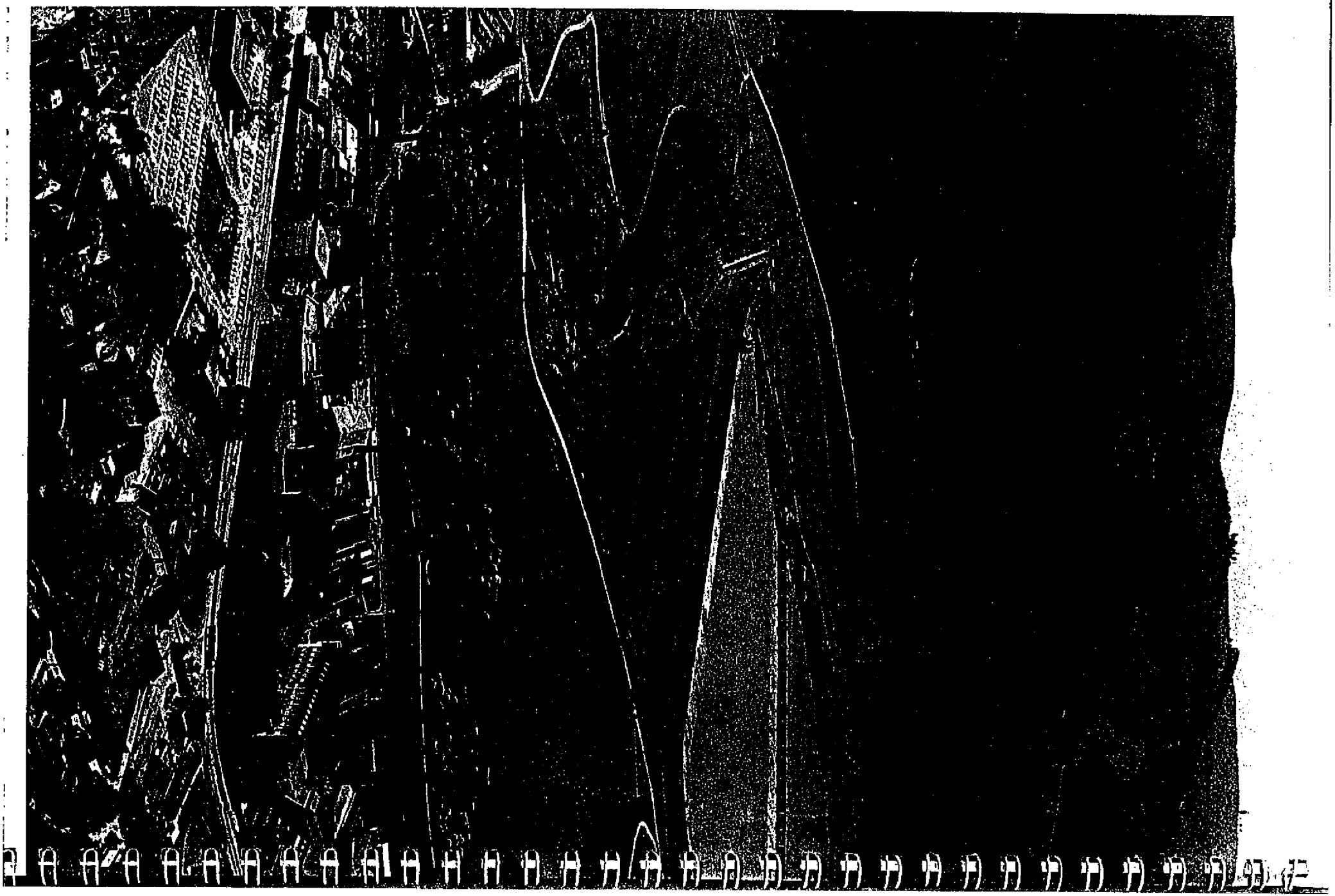
L. H. Belz
MAY '85

Metallurgical

Remarks

General

Tantalum
Niobium



Tantalum by HCST

HCST known world-wide for its high quality metallurgical products, has been involved with the production of tantalum since 1949.

Since this time ***HCST*** has developed into one of the most important and experienced producers of tantalum in the world.

The development of the past years has shown that a sound raw material policy is the most important pre-condition for a tantalum production.

Therefore from the beginning ***HCST*** attached great importance to perform the tantalum extraction process in its own works starting from the raw material.

HCST therefore has designed and built extraction and separation plants for tantalum/niobium which permit great flexibility in operation by using wet chemical extraction or chlorination techniques.

This flexibility of operation permits the use of high grade tantalum ores such as tantalite and microlite with tantalum contents up to 70% as well as columbite and low grade by-products from other processes such as tin slags.

Besides ***HCST*** provides two ways to assure the supply of tantalum:

First, by developing new processes for recovering tantalum ores with lower and lower Ta-contents and secondly by developing Ta-powders for the capacitor industry with higher and higher capacitance thus insuring better utilization of the tantalum still available. (Powder type PL-18000 R today represents world-wide the powder with the highest yield of capacitance)

The research and development department of ***HCST*** is working very intensively in this field today.

The processes which are common practice at ***HCST*** are based on the application of the following ***HCST*** patents and the following pending patents:

DE-PS 2133104
DE-PS 2517180
DE-PS 2537354
DE-PS 2610224

DE-OS 2733193
DE-OS 3005207
DE-OS 3113335
DE-OS 3130392

or of the corresponding foreign patents.

Tantalum and Niobium Products by HCST

This catalogue deals with the tantalum and niobium products offered by ***HCST***. Special importance is being attached to the powder grades used for the production of tantalum capacitors.

Capacitor Grades

The following items are included in our list of tantalum "Capacitor Grade" products:

1. Tantalum powder – "Capacitor Grade"
   Series PL: Powders of high to highest capacitance for medium working voltage.
   Series 600: Powders of high purity of low to high capacitance for high to highest working voltage.

2. Sintered tantalum anodes for electrolytic capacitors.

3. Niobium powder "Capacitor Grade" (on request).

Metallurgical Grades

Other tantalum and niobium products manufactured by ***HCST*** include:

5. Tantalum metal "Metallurgical Grade".
   5.1 Tantalum metal powder for powder metallurgy.
   5.2 Tantalum metal powder and pellets for melting.
   5.3 Tantalum scrap.

6. Tantalum for special purposes.
   6.1 Tantalum powder "Spraying Grade".
   6.2 Tantalum powder "Sub-Micron-Powder" (on request).
   6.3 Tantalum powder with especially high purity for scientific purpose.

7. Tantalum electron beam melted ingots.

8. Tantalum carbide, niobium carbide, tantalum-niobium carbide and tantalum-bearing triple and tetra carbides for the cemented carbide industry.

9. Tantalum oxide, niobium oxide and tantalum-niobium oxide chemical pure and of highest purity for the optical and ceramic industry. This includes the application for ceramic capacitors also.

10. Tantalum chloride, niobium chloride for surface coatings and other applications.

11. Potassium tantalum fluoride.

Should you be interested in these products, please ask for further informations.

Metallurgical

Remarks

Tantalum Powder Capacitor Grade
Grade PL-8000

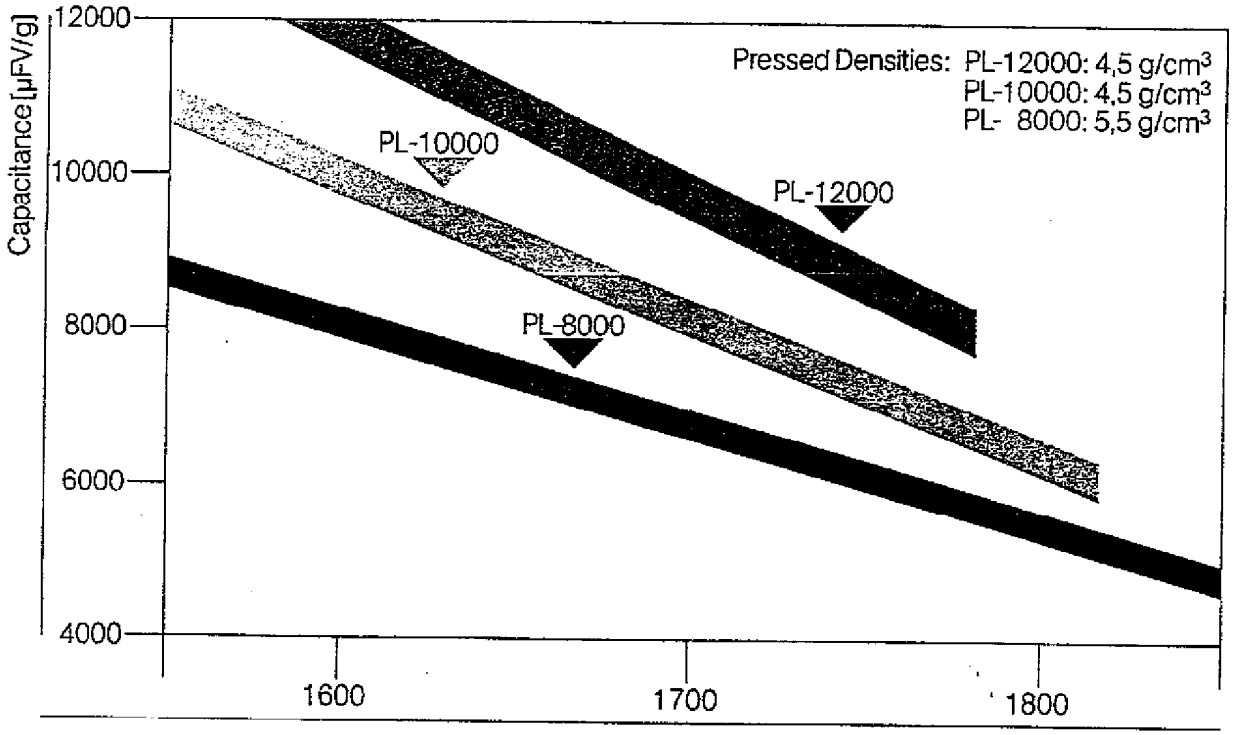
PL-8000

PL-8000 represents the powder with the lowest yield of capacitance per gram and the highest working voltage in the PL-series. It has a good flowability and permits pressed densities down to 5.0 g/cm³. PL-8000 is recommended especially for the production of medium voltage 35 V capacitors.

Recommended conditions for processing

Sintering temperature:	1600 – 1850°C
Sintering time:	15 – 30 minutes
Pressed density:	5,0 – 6,0 g/cm³ can also be pressed without binder
Yield of capacitance:	5000 – 8000 µFV/g (Wet test)
Working voltage:	up to 35 V

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
PL-8000	8000	47500	1600	180	0,4
PL-8000	6800	44000	1700	200	0,30
PL-8000	5500	38500	1800	220	0,2

Anode weight: 0,4 g, Pressed density: 5,5 g/cm³
Sintering time: 30 min, Formation voltage: 100 V

Series 600 (900)

660, 690-E, 690-S and 900-HC are the so-called "electron beam melted" powders. Their low contamination with impurities provides a high reliability at the highest working voltages.

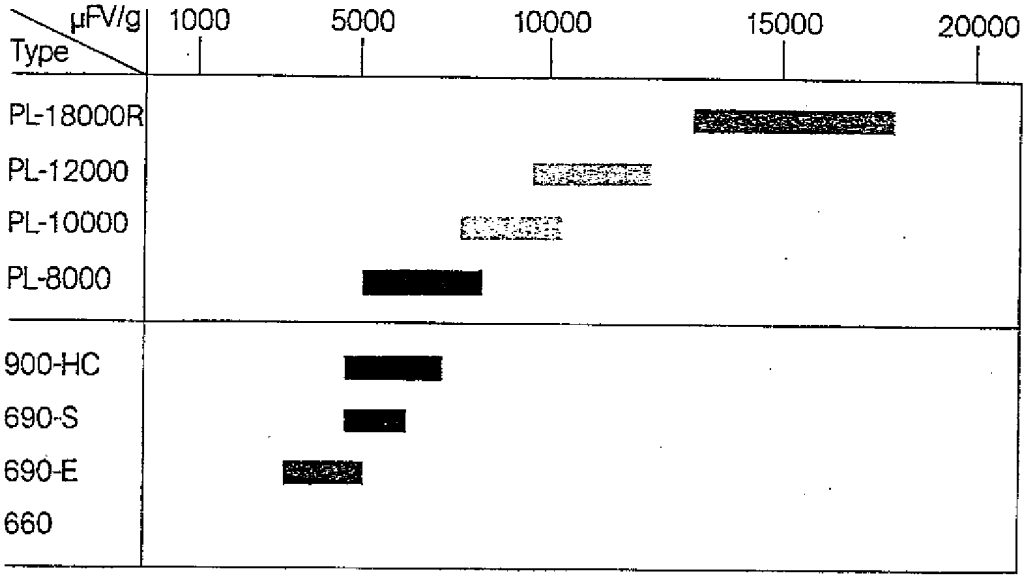
The powders of this series are showing the following properties which are important for processing:

1. They can be pressed without binder
2. They show an excellent flowability
3. The high strength of the agglomerates guarantees that the excess powder does not show any significant change in processing.

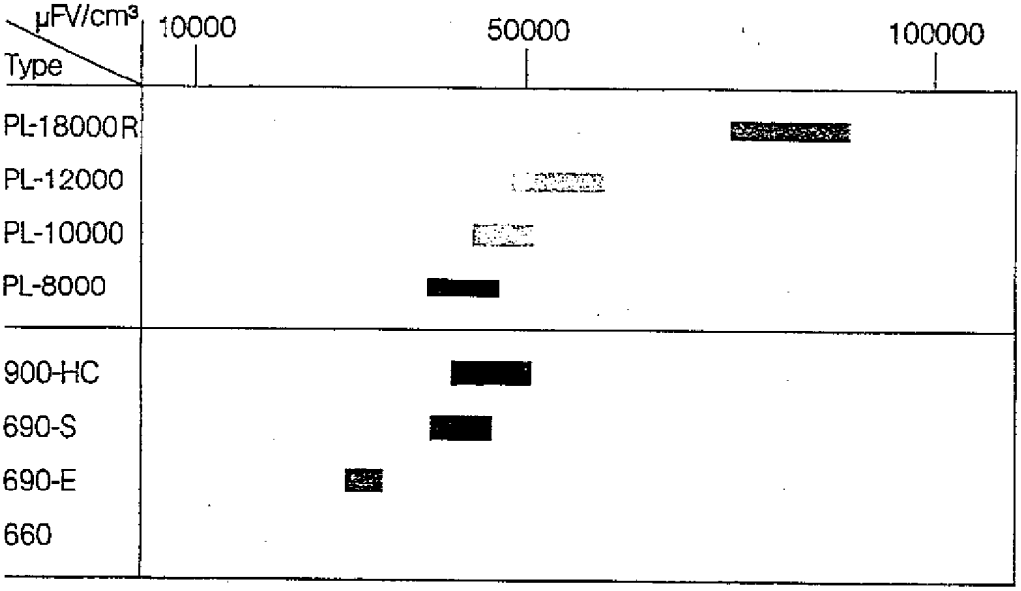
All the characteristics, such as capacitance per gram, capacitance per volume of the two powder series, are shown on the following tables.

In the attached data sheets you will find further particulars of the powders discussed.

Capacitance per Gram



Capacitance per Volume



Quality Control

A considerable amount of highly skilled analytical effort is employed to ensure consistently high quality in our tantalum products. This applies even to the starting materials such as the ores and the chemicals used to process them.

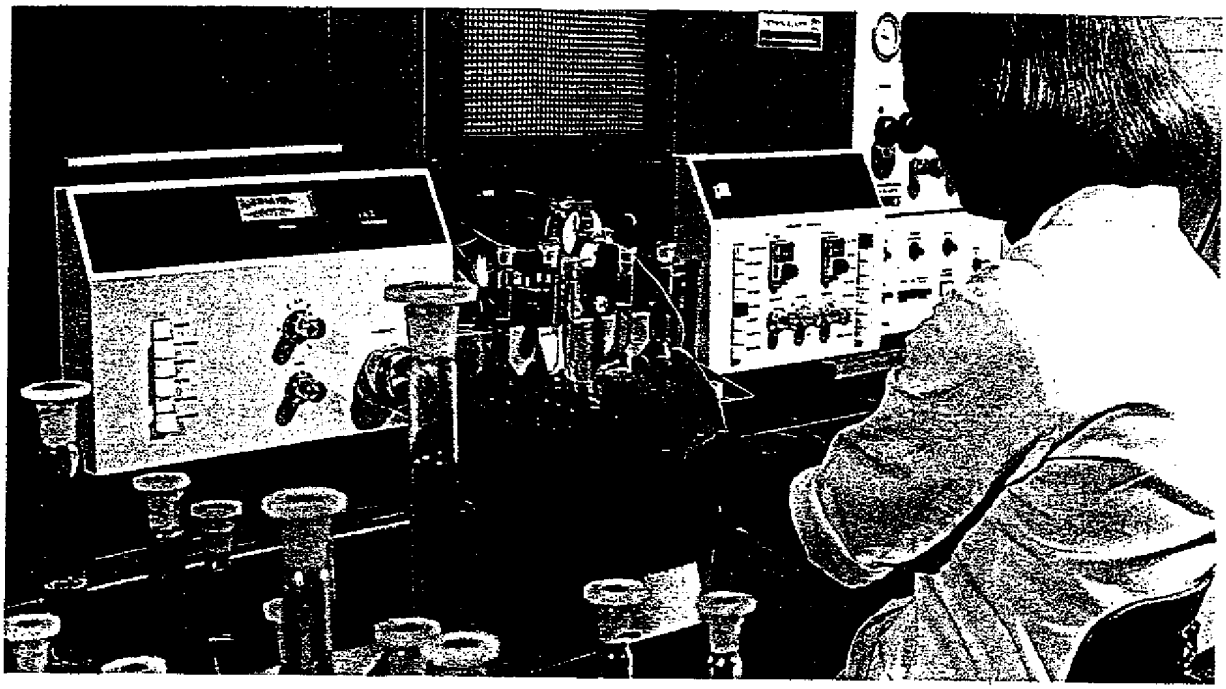
Every step in the processing is carefully controlled, especially in the stages liable to have influence on the electrical, physical and chemical properties of the final product.

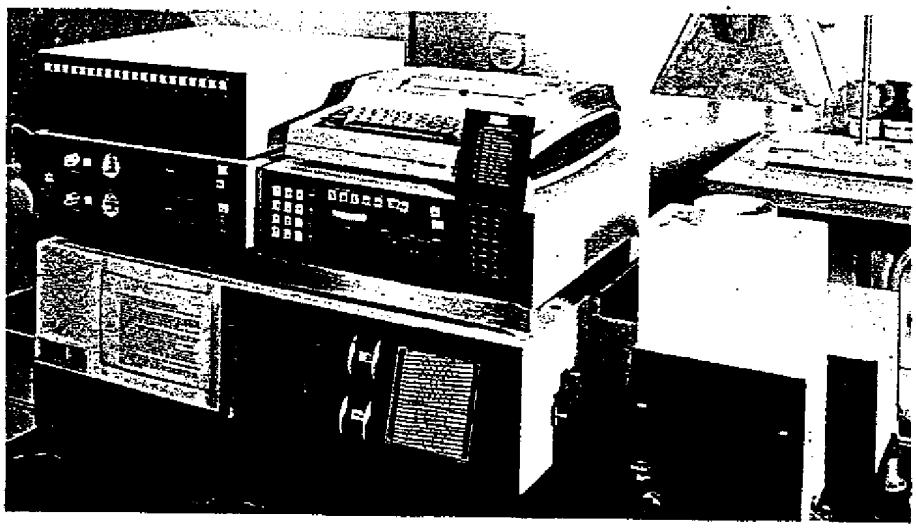
Among the methods we use are:

Determination of Metallic Contaminations

Emission spectroscopy	(3,5 m RSV, Plan-gitterspectrograph)
Spectrophotometry	(Spectronic 88, Bausch & Lomb)
X-ray fluorescence analysis	(Philips PW 1450/PW 1410)
Atom absorption	(Perkin-Elmer 503)

Plasma Spectrometer (DC-Argon Plasma Echelle Spectrometer Spectrometrics Plasma Spectraspan III)





Atomic absorption spectrometer.

Plasma spectrometer

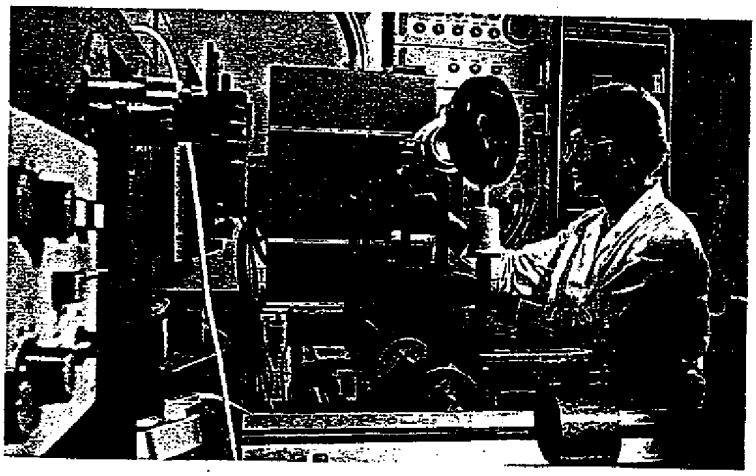
Determination of the Gas Content (Oxygen, Hydrogen, Nitrogen)

Vacuum fusion	(Leybold-Heraeus VH 9, Gas Evolograph 0583 St. Re
Inert-carrier-gas fusion	(Leco TC 136)

Determination of Carbon

Coulometric analysis	(Schoeps apparatus CTA 5 C)

Inert-carrier-gas fusion (Leco TC 136)



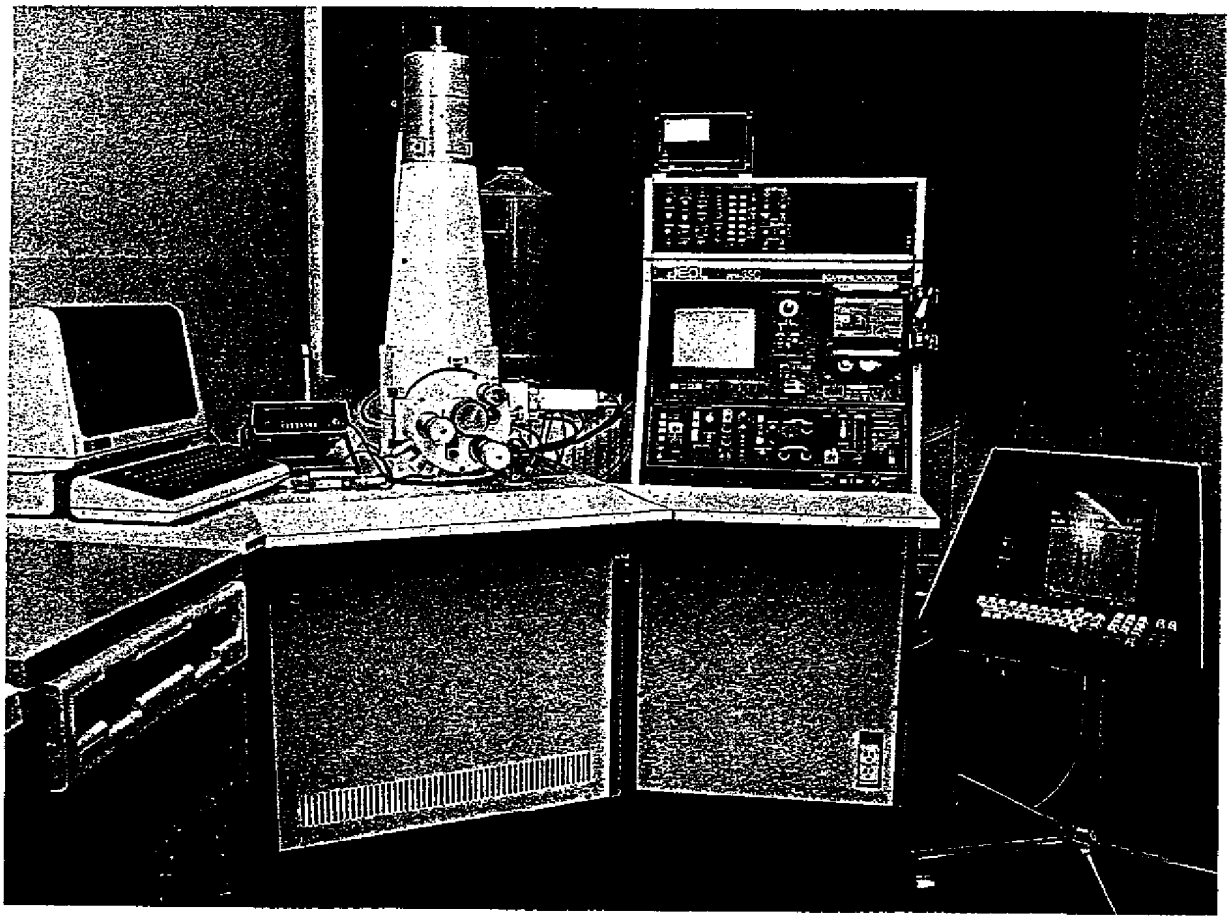
3.5-m plane grating spectograph for photographic and photoelectric recording, combined with an arc-sparc stand and a glow discharge lamp.

Physical Properties

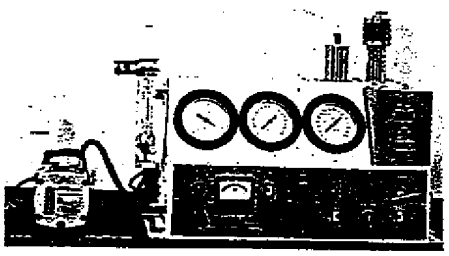
Scott density	(Scott, ASTM: B 329 – 76)
Average particle size	(Fisher Sub-Sieve Sizer, ASTM: B 330 – 82)
Screen distribution	(DIN or ASTM: B 214 – 76, E 11)
Flow properties	(Hall-Flow-Index, ASTM: B 213 – 77)
Particle size distribution	(Sedimentation: WAB, ASTM: B 430 – 79) Roller Analyzer, ASTM: 293 – 76)

In addition these are several methods for determining further physical properties by means of

Scanning Electron Microscope	(Jeol JSM-T 100, JSM-35 C)
Mercury Porosimetry and BET method specific surface	(DIN 66132)
Sedigraph	(5000 D, Micromeritics)



Scanning electron microscope with energy dispersive micro-analysis



Mercury porosimeter

Test Conditions (Wet Test)

	270 V	200 V	100 V (70 V)
Formation conditions:			
Electrolyte	0,01 wt-% H_3PO_4	0,01 wt-% H_3PO_4	0,01 wt-% H_3PO_4
Temperature	90 ± 2°C	90 ± 2°C	90 ± 2°C
Formation voltage	270 V	200 V	100 V (70 V)
Final voltage held for	120 min	120 min	120 min
Formation Current	35 mA/g (0–200 V) 12 mA/g (201–270 V)	35 mA/g	35 mA/g
Measurement conditions for capacitance and ESR (after washing and drying)			
Electrolyte	10 wt-% H_3PO_4	10 wt-% H_3PO_4	10 wt-% H_3PO_4
Temperature	23 ± 2°C	23 ± 2°C	23 ± 2°C
D.C. Bias	2,0 V	2,0 V	2,0 V
A.C. Signal	0,5 V	0,5 V	0,5 V
Frequency	120 cps	120 cps	120 cps
Measurement conditions for leakage current			
Electrolyte	10 wt-% H_3PO_4	10 wt-% H_3PO_4	10 wt-% H_3PO_4
Temperature	23 ± 2°C	23 ± 2°C	23 ± 2°C
Voltage	240 V	140 V	70 V (47 V)
Charging time	2 min	2 min	2 min
Measurement conditions for dissipation factor (after washing and drying)			
Electrolyte	10 wt-% H_3PO_4	10 wt-% H_3PO_4	10 wt-% H_3PO_4
Temperature	23 ± 2°C	23 ± 2°C	23 ± 2°C
D.C. Bias	2,0 V	2,0 V	2,0 V
A.C. Signal	0,5 V	0,5 V	0,5 V
Frequency	120 cps	120 cps	120 cps
Measurement conditions for breakdown voltage			
Electrolyte	1 wt-% H_3PO_4	1 wt-% H_3PO_4	1 wt-% H_3PO_4
Temperature	90 ± 2°C	90 ± 2°C	90 ± 2°C
Current	35 mA/g	35 mA/g	35 mA/g

Other testing conditions can be applied according to customers requirements

Tantalum Powder Capacitor Grade
Grade PL-8000

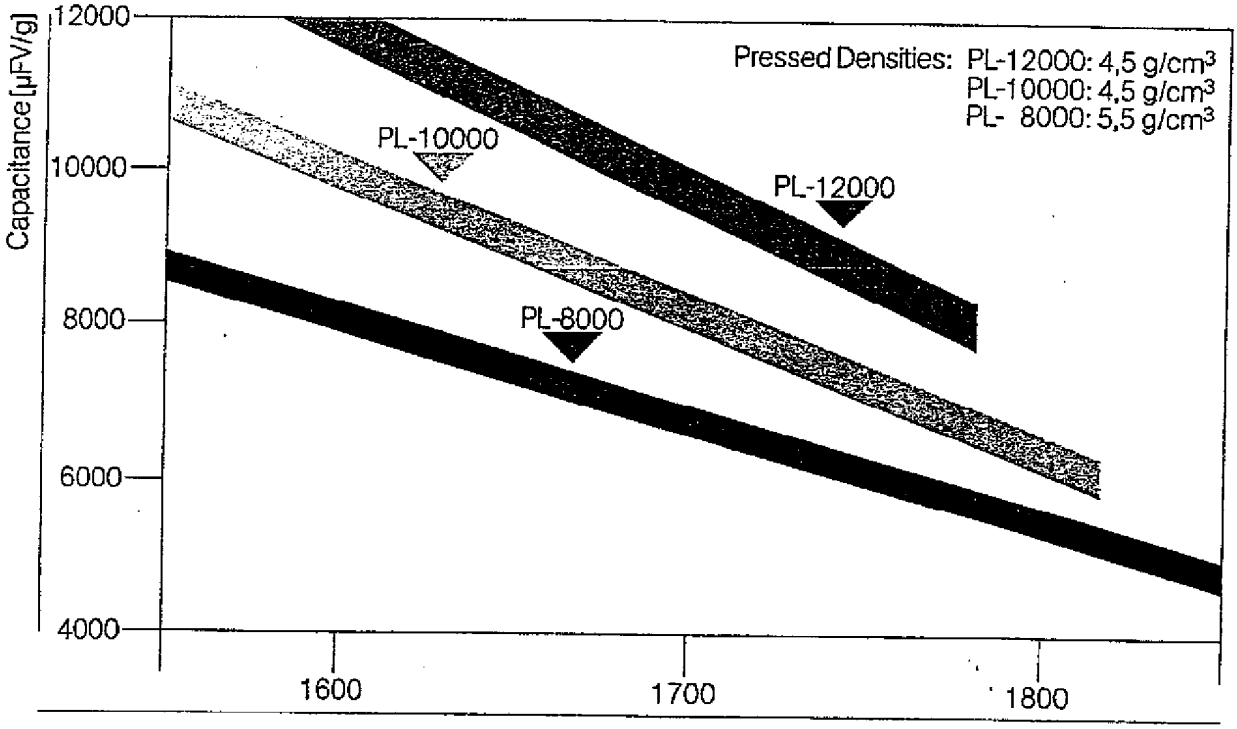
PL-8000

PL-8000 represents the powder with the lowest yield of capacitance per gram and the highest working voltage in the PL-series. It has a good flowability and permits pressed densities down to 5.0 g/cm³. PL-8000 is recommended especially for the production of medium voltage 35 V capacitors.

Recommended conditions for processing

Sintering temperature:	1600 – 1850°C
Sintering time:	15 – 30 minutes
Pressed density:	5,0 – 6,0 g/cm³ can also be pressed without binder
Yield of capacitance:	5000 – 8000 µFV/g (Wet test)
Working voltage:	up to 35 V

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/uFV)
PL-8000	8000	47500	1600	180	0,4
PL-8000	6800	44000	1700	200	0,30
PL-8000	5500	38500	1800	220	0,2

Anode weight: 0,4 g, Pressed density: 5,5 g/cm³
Sintering time: 30 min, Formation voltage: 100 V

PL-8000

Typical Chemical Analysis

Elements	H	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	10	75	2000	75	50	50	50	10	20	20

Typical Physical Characteristics

Scott Density (according to ASTM No. B 329–76)

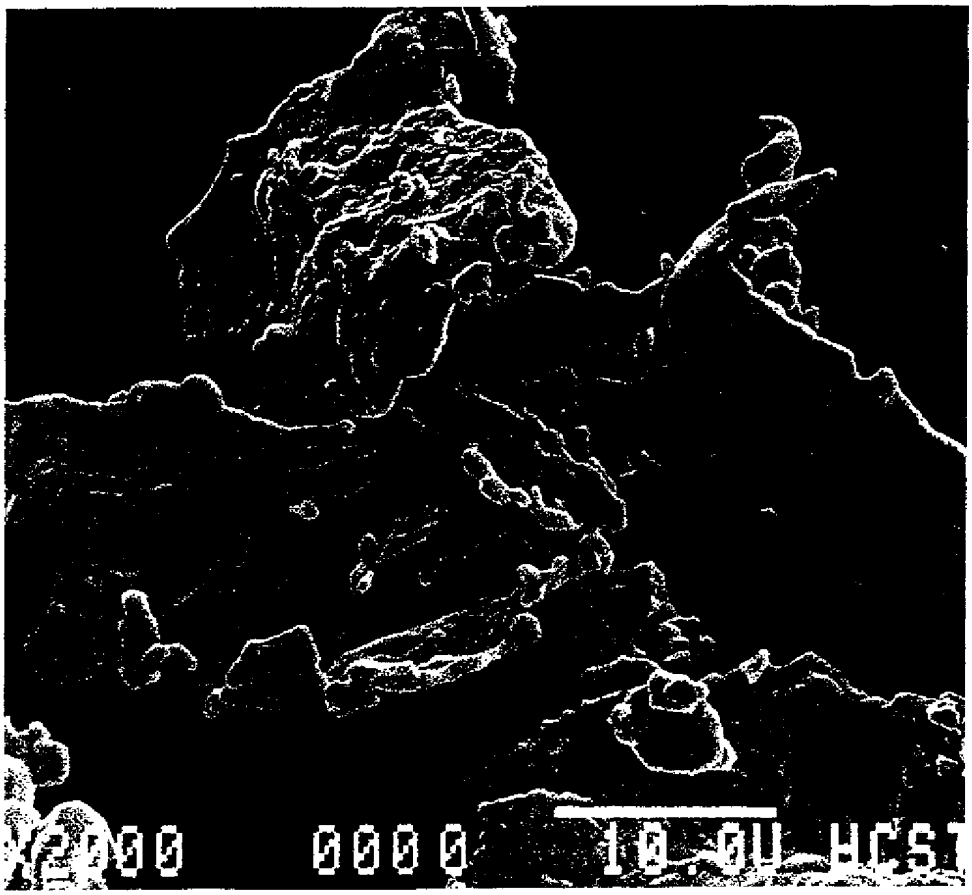
g/in³: 30 –40
g/cm³: 1,8– 2,4

Fisher Sub-Sieve Size (according to ASTM No. B 330–82)

µm: 4,0 – 5,5

Screen Distribution (according to ASTM No. B 214–76, E 11)

+200 mesh	–200 +325 mesh	–325 mesh
20–50%	10–30%	40–60%



PL-8000 *Scanning electron micrograph*

PL-10000

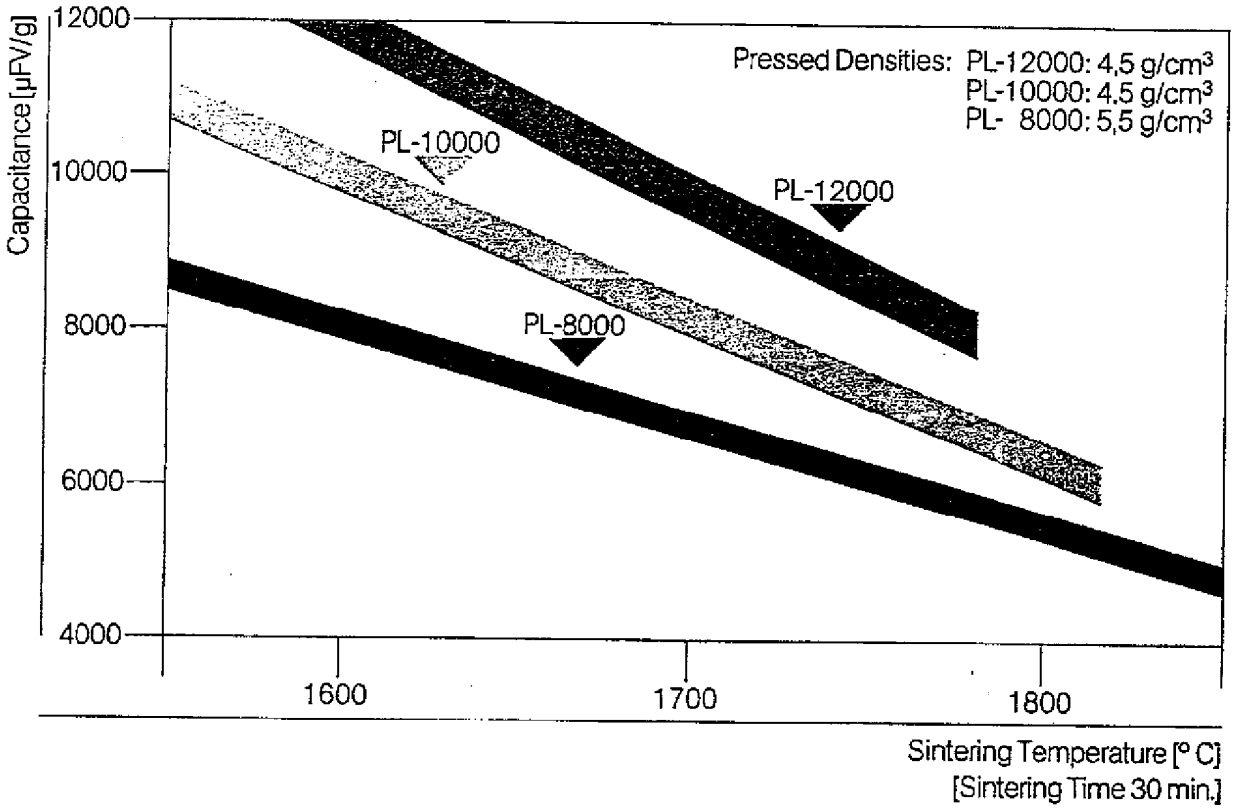
Tantalum Powder Capacitor Grade
Grade PL-10000

PL-10000 was the first powder with a yield of capacitance of more than 10000 µFV/g. Its excellent physical properties permit pressed densities down to 4.0 g/cm³. PL-10000 is recommended for the production of capacitors up to 35 V.

Recommended conditions for processing

Sintering temperature:	1600–1750°C
Sintering time:	15 –30 minutes
Pressed density:	4,0 – 5,0 g/cm³ can also be pressed without binder
Yield of capacitance:	7500–10000 µFV/g (Wet test)
Working voltage:	up to 35 V

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
PL-10000	10000	49000	1600	170	0,5
PL-10000	9100	47000	1650	180	0,4
PL-10000	8200	45000	1700	190	0,3

Anode weight: 0,4 g, Pressed density: 4,5 g/cm³
Sintering time: 30 min, Formation voltage: 100 V

PL-10000

Typical Chemical Analysis

Elements	H	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	10	75	2400	75	50	50	50	10	20	20

Typical Physical Characteristics

Scott Density (according to ASTM No. B 329–76)

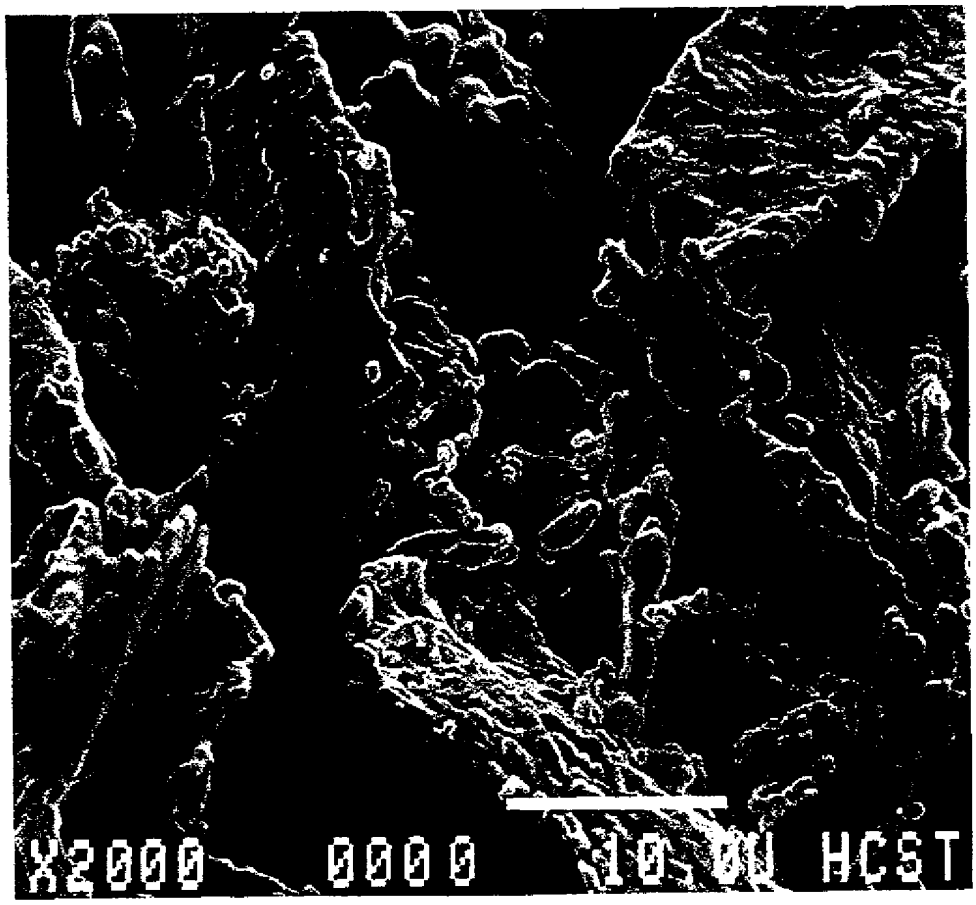
g/in³ : 20 –35
g/cm³ : 1,2– 2,1

Fisher Sub-Sieve Size (according to ASTM No. B 330–82)

µm: 2,5 – 4,5

Screen Distribution (according to ASTM No. B 214–76, E 11)

+200 mesh	–200+325 mesh	–325 mesh
10–30%	10–30%	40–60%



PL-10000 *Scanning electron micrograph*

Tantalum Powder Capacitor Grade
Grade PL-12000

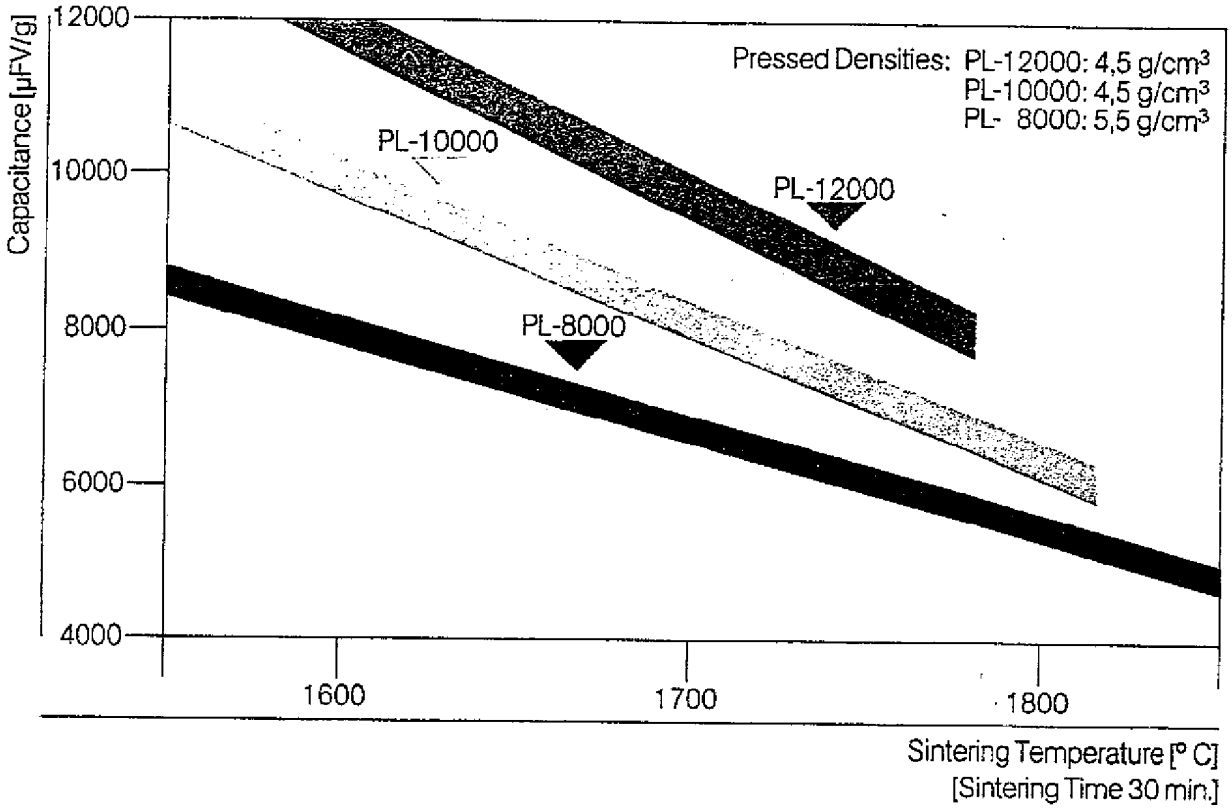
PL-12000

PL-12000 today represents the powder with the highest yield of capacitance at normal sinterconditions of minimum 1600 °C, 30 min (12000 µFV/g). Its high green strength also permits pressed densities of 4,0 – 5,0 g/cm³. PL-12000 corresponds to the data of PL-10000 as to its processing qualities.

Recommended conditions for processing

Sintering temperature:	1600 – 1750°C
Sintering time:	15 – 30 minutes
Pressed density:	4,0 – 5,0 g/cm³ can be pressed without binder
Yield of capacitance:	9000 – 12000 µFV/g (Wet test)
Working voltage	up to 35 V

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
PL–12000	12000	58000	1600	160	0,5
PL–12000	10700	53500	1650	170	0,35
PL–12000	9800	50000	1700	180	0,25

Anode weight: 0,4 g, Pressed density: 4,5 g/cm³
Sintering time: 30 min, Formation voltage: 100 V

PL-12000

Typical Chemical Analysis

Elements	H	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	10	200	2700	100	50	50	50	10	20	20

Typical Physical Characteristics

Scott Density (according to ASTM: B 329–76)

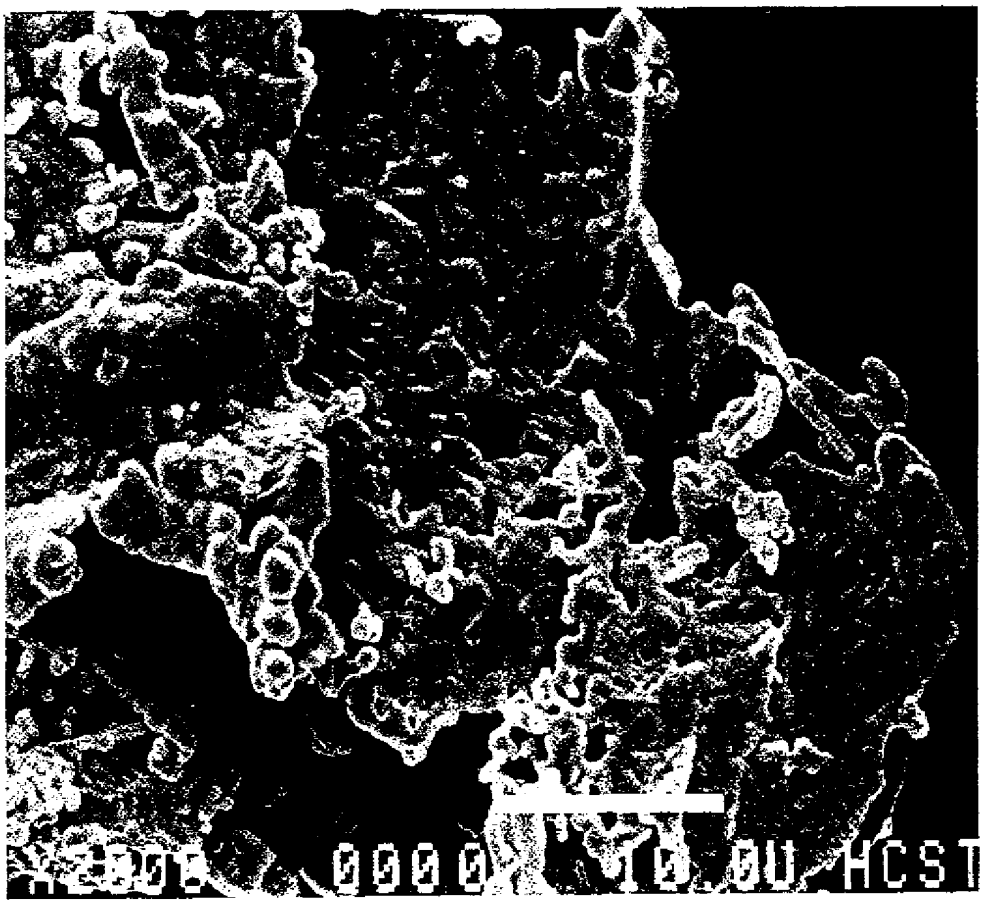
g/in³ : 15 – 25
g/cm³: 0,9 – 1,5

Fisher Sub-Sieve Size (according to ASTM No. B 330–82)

µm: 2,0 – 3,5

Screen Distribution (according to ASTM: B 214–76, E 11)

+200 mesh	−200 +325 mesh	−325 mesh
10–30%	10–30%	40–60%



PL-12000 *Scanning electron micrograph*

Tantalum Powder Capacitor Grade
Grade PL-18000 R

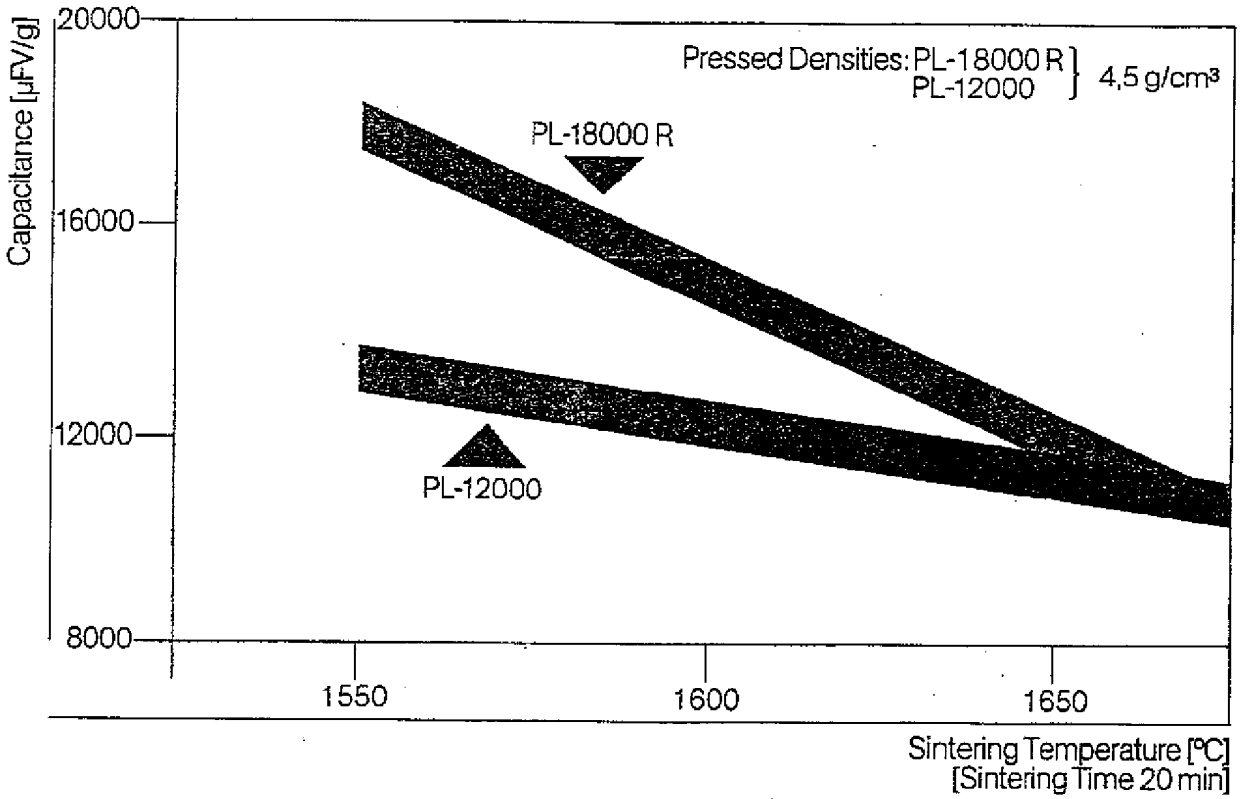
PL-18000 R

PL-18000 R is a consistent improvement over PL-18000 with regard to better physical properties like flowability and green strength at low pressed density.
Further on it can be characterized by an outstanding low level of oxygen which has to be related to the high capacitance of this powder.
Because of the improved stability of PL-18000 R particles preparation of pellets is possible at a green density of 4,5 g/cm³.

Recommended conditions for processing

Sintering temperature:	1550–1700 °C
Sintering time:	5 –20 minutes
Pressed density:	4,5–5,5 g/cm³ can be pressed without binder
Yield of capacitance:	13000–18000 µFV/g (wet test)
Working voltage:	up to 25 V

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
PL-18000 R	18000	90000	1550	120	0,3
PL-18000 R	15000	95000	1600	130	0,3
PL-18000 R	12000	77500	1650	140	0,2

Anode weight: 0,2 g, Pressed density: 4,5 g/cm³
Sintering time: 20 min. Formation voltage: 70 V

PL-18000 R

Typical Chemical Analysis

Elements	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	200	1700	90	60	50	50	10	20	20

Typical Physical Characteristics

Scott Density (according to ASTM: B 329-76)

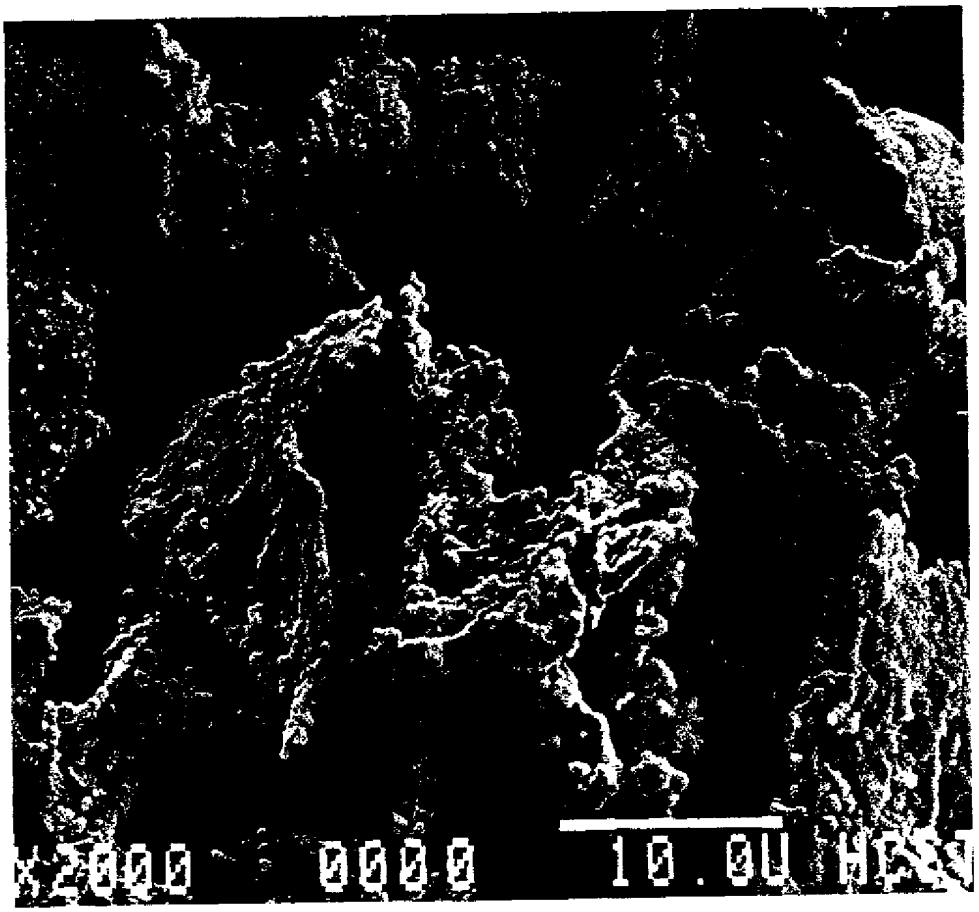
g/in³ : 15–20
g/cm³: 0,9–1,3

Fisher Sub-Sieve Size (according to ASTM: B 330–82)

µm : 0,9–1,8

Screen Distribution (according to ASTM: B 214–76, E 11

100%–45 mesh



PL-18000 R *Scanning electron micrograph*

Tantalum Powder Capacitor Grade
Grade PL-22000

PL-22000

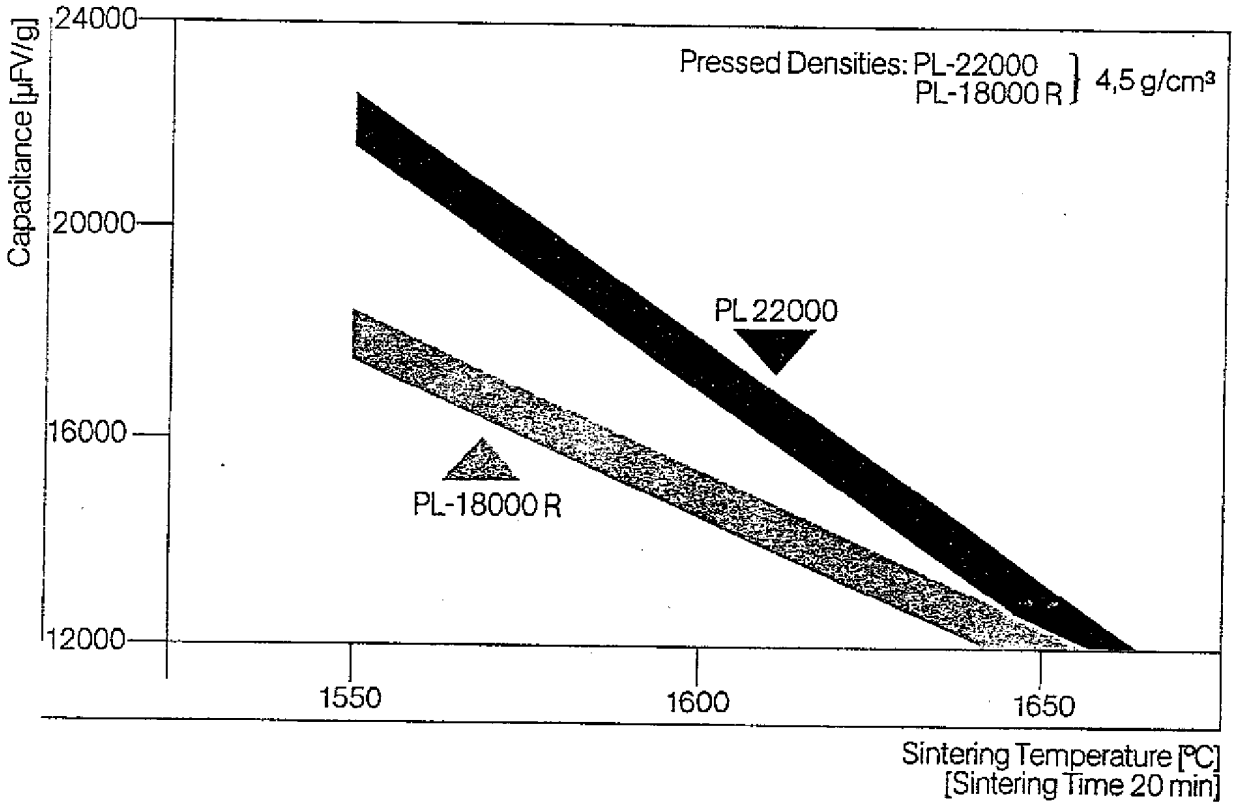
PL-22000 combines all the qualities of the PL-series with the highest yield of capacitance presently available in the market.

Its remarkably high yield of capacitance per unit volume should allow a further miniturization of capacitors under fixed conditions.

Recommended conditions for processing

Sintering temperature:	1500–1700 °C
Sintering time:	5–20 minutes
Pressed density:	4.5–5.5 g/cm³
	can be pressed without binder
Yield of capacitance:	15000–22000 µFV/g
	(wet test)
Working voltage:	up to 25 V

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
PL-22000	22000	110000	1550	120	0,3
PL-22000	17000	95000	1600	130	0,3
PL-22000	13000	77500	1650	140	0,2

Anode weight: 0,2 g, Pressed density: 4,5 g/cm³
Sintering time: 20 min, Formation voltage: 70 V

PL-22000

Typical Chemical Analysis

Elements	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	200	2000	100	60	50	50	10	20	20

Typical Physical Characteristics

Scott Density (according to ASTM: B 329-76)

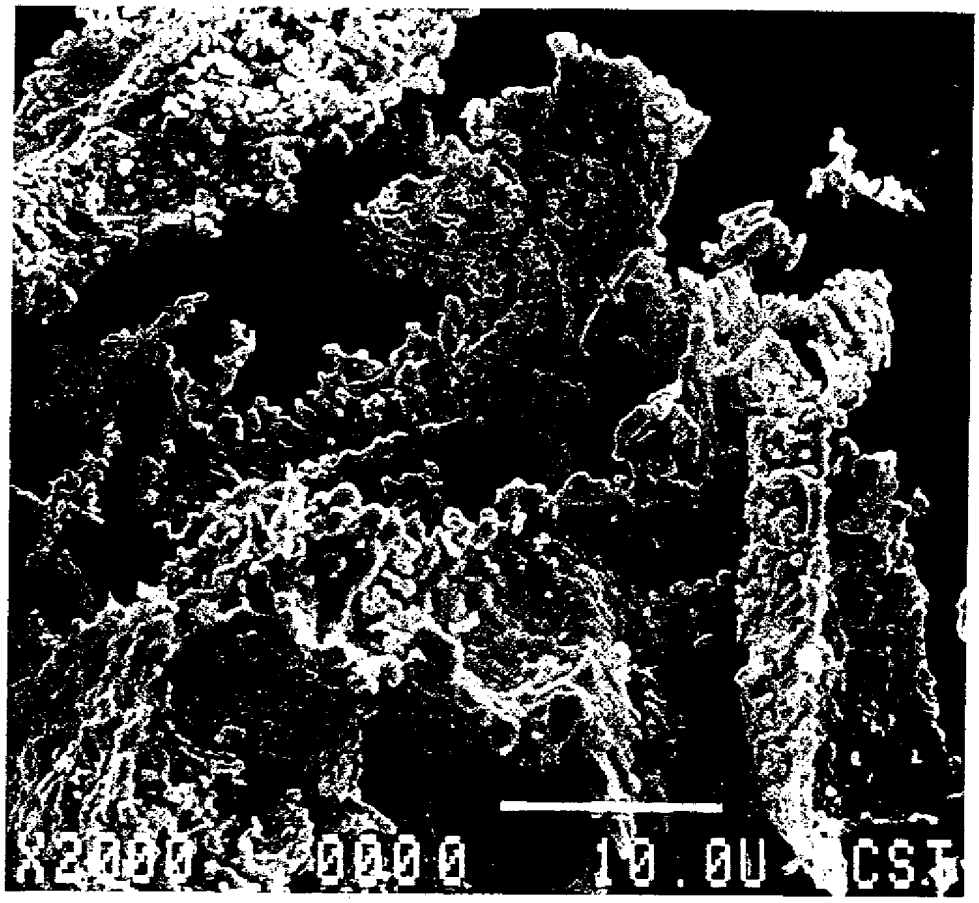
g/in³ : 15–20
g/cm³: 0,9–1,3

Fisher Sub-Sieve Size (according to ASTM: B 330–82)

µm : 0,9–1,3

Screen Distribution (according to ASTM: B 214–76, E 11

100%–45 mesh



PL-22000 *Scanning electron micrograph*

Tantalum Powder Capacitor Grade
Grade 660

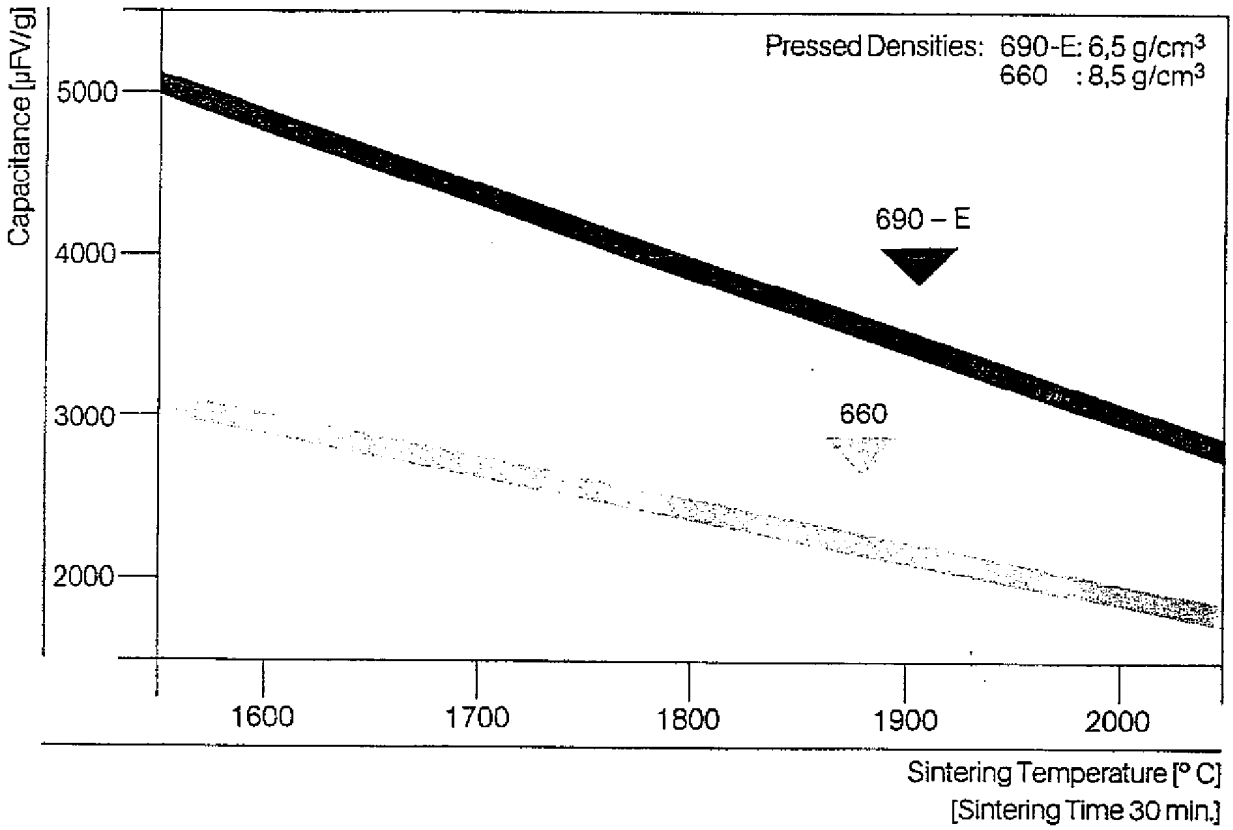
The application of grade 660 is in the high to highest working voltage area.

Because of the purity (EB-melting), this powder is very important for the production of capacitors with high reliability (MIL-Spec. No. C 39003)

Recommended conditions for processing

Sintering temperature:	1850–2000°C
Sintering time:	30–40 minutes
Pressed density:	7,5–9,5 g/cm³
Yield of capacitance:	1900–2400 µFV/g
Working voltage:	50 V

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
660	2350	21800	1850	230	0,50
660	2000	19500	2000	250	0,30

Anode weight: 4,0 g, Pressed density: 8,5 g/cm³
Sintering time: 30 min, Formation voltage: 200 V

Typical Chemical Analysis

Elements	H	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	10	35	1300	30	20	35	10	5	10	10

Typical Physical Characteristics

Scott Density (according to ASTM No. B 329–76)

g/in³ : 85 –100
g/cm³: 5,2– 6,1

Fisher Sub-Sieve Size (according to ASTM No. B 330–82)

µm : 8,0– 10,0

Screen Distribution (according to ASTM No. B 214–76, E 11)

+200 mesh	–200+325 mesh	–325 mesh
10–20%	10–20%	50–80%

Tantalum Powder Capacitor Grade
Grade 690-E

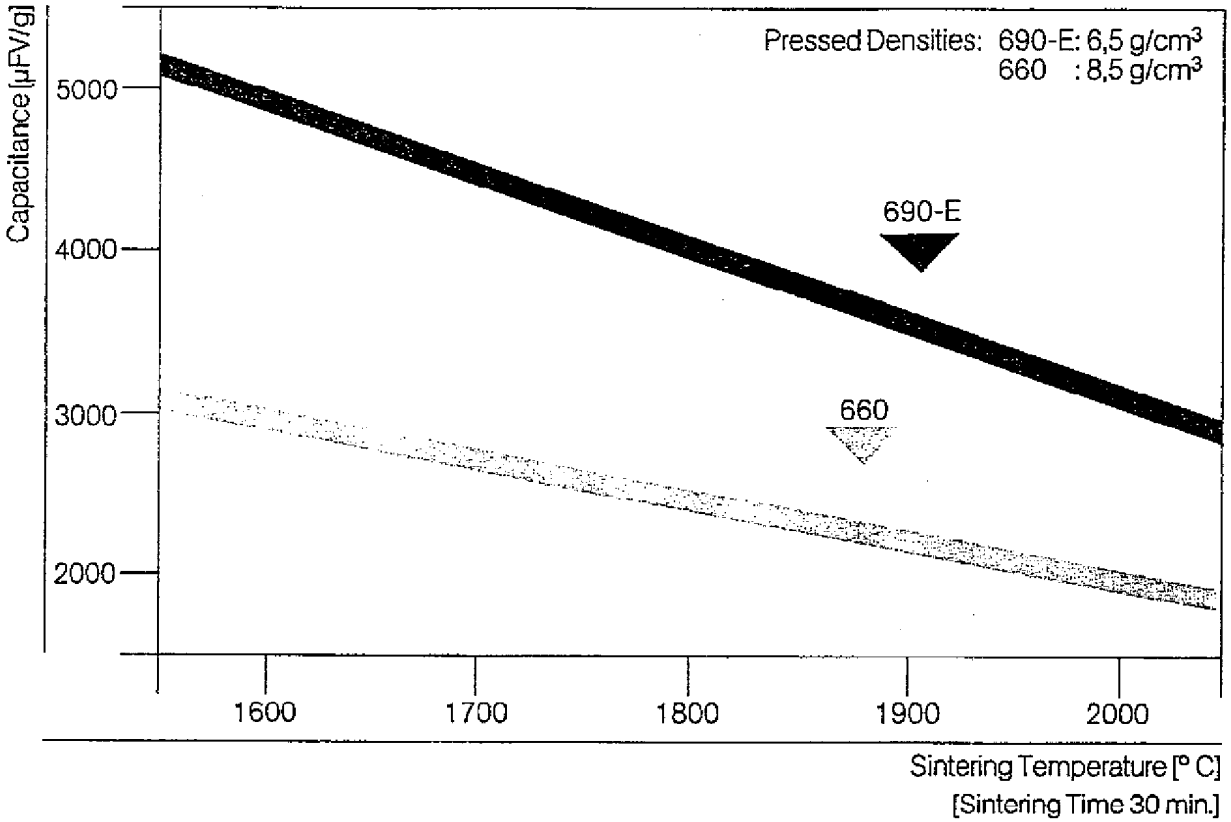
690-E

690-E is an improved EB-melted high capacitive powder. Its outstanding physical properties are: formability without binder, very good green strength and good flowability.

Recommended conditions for processing

Sintering temperature:	1600–1950°C
Sintering time:	15–40 minutes, can be pressed without binder
Pressed density:	6,5–7,5 g/cm³
Yield of capacitance:	3000–5000 µFV/g
Working voltage:	up to 50 V

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
690-E	4650	33400	1650	190	0,4
690-E	3750	32000	1850	240	0,3

Anode weight: 1,0 g, Pressed density: 7,0 g/cm³
Sintering time: 30 min, Formation voltage: 200 V

690-E

Typical Chemical Analysis

Elements	H	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	10	35	1600	40	25	35	10	5	10	10

Typical Physical Characteristics

Scott Density (according to ASTM: B 329–76)

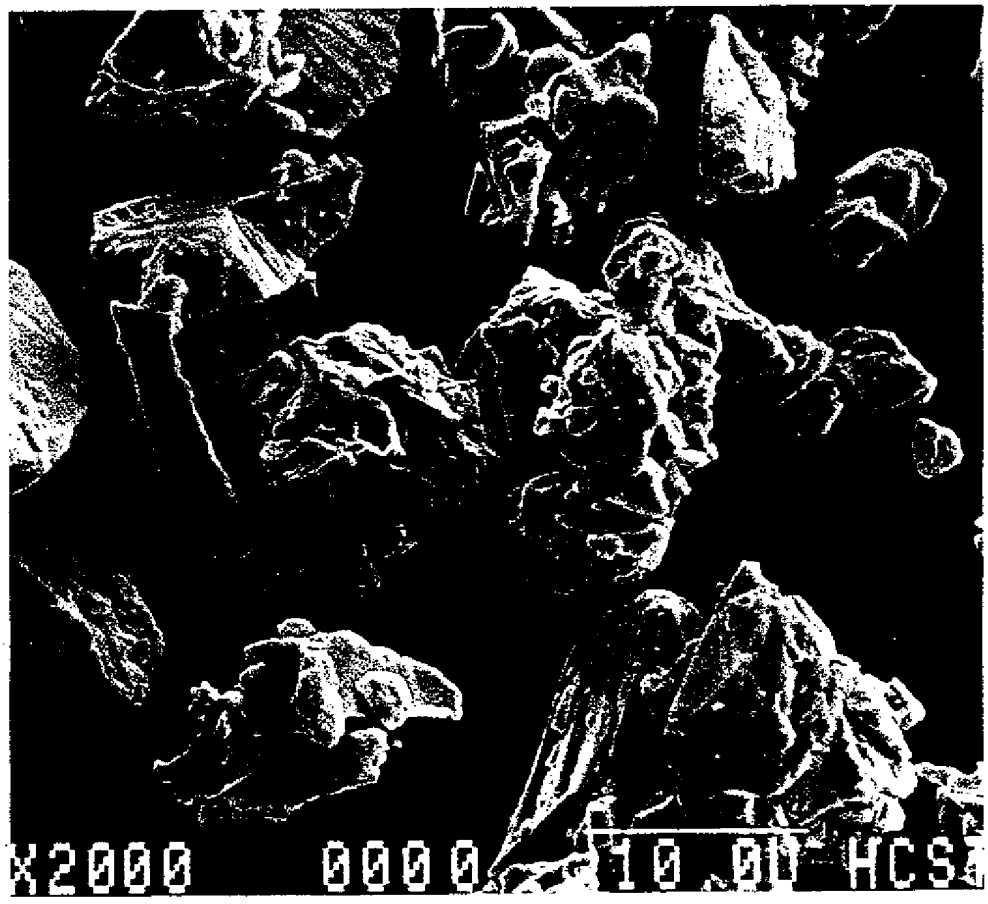
g/in^3 : 60 – 75
g/cm^3 : 3,6– 4,6

Fisher Sub-Sieve Size (according to ASTM: B 330–82)

µm : 7–12

Screen Distribution (according to ASTM: B 214–76, E 11)

+200 mesh	–200+325 mesh	–325 mesh
40–65%	5–15%	30–50%



690-E *Scanning electron micrograph*

690-S

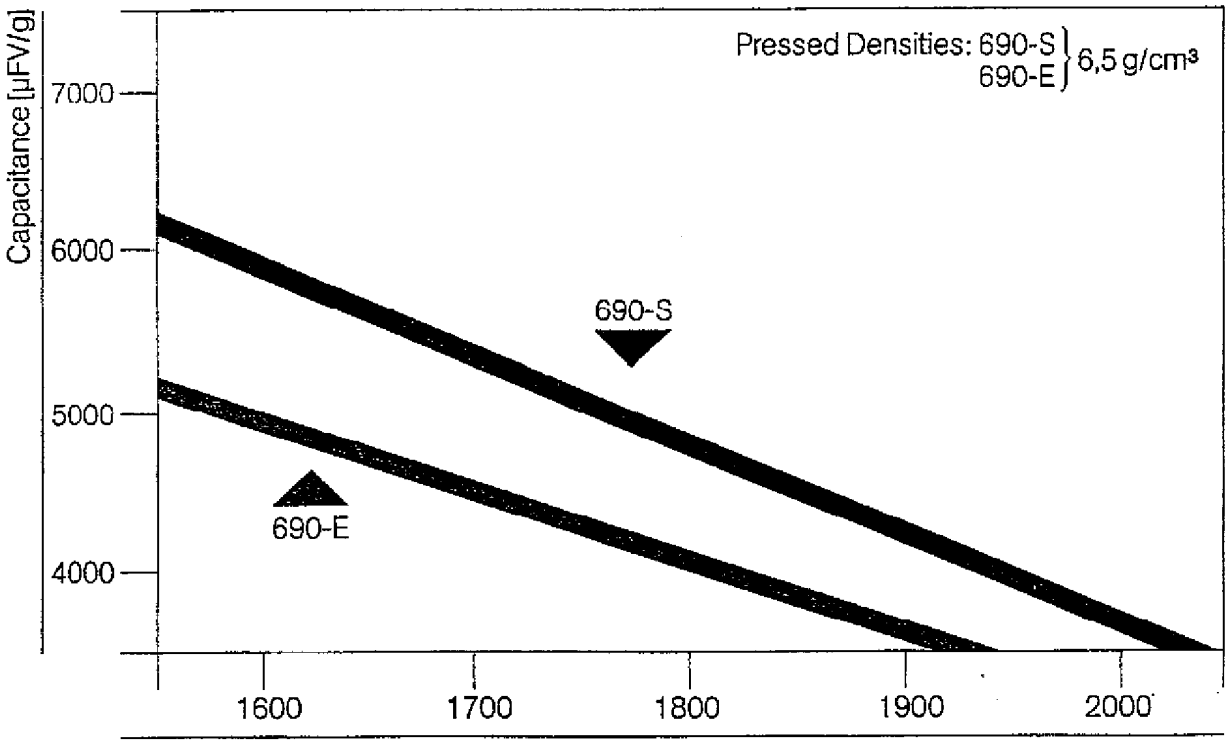
Tantalum Powder Capacitor Grade
Grade 690-S

690-S is a newly developed EB-melted high capacitance powder with all the physical properties of 690-E, such as excellent pressing characteristics without binder, good green strength and good flowability.

Recommended conditions for processing

Sintering temperature:	1600–1850°C
Sintering time:	30–40 minutes
Pressed density:	6,5–7,5 g/cm³
	can be pressed without binder
Yield of capacitance:	4500–6000 µFV/g
Working voltage:	35 V and over

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
690-S	5650	49000	1650	190	0,4
690-S	4250	41000	1850	240	0,3

Anode weight: 1,0 g, Pressed density: 7,0 g/cm³
Sintering time: 30 min, Formation voltage: 200 V

690-S

Typical Chemical Analysis

Elements	H	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	10	35	1700	40	25	35	10	5	10	10

Typical Physical Characteristics

Scott Density (according to ASTM: B 329–76)

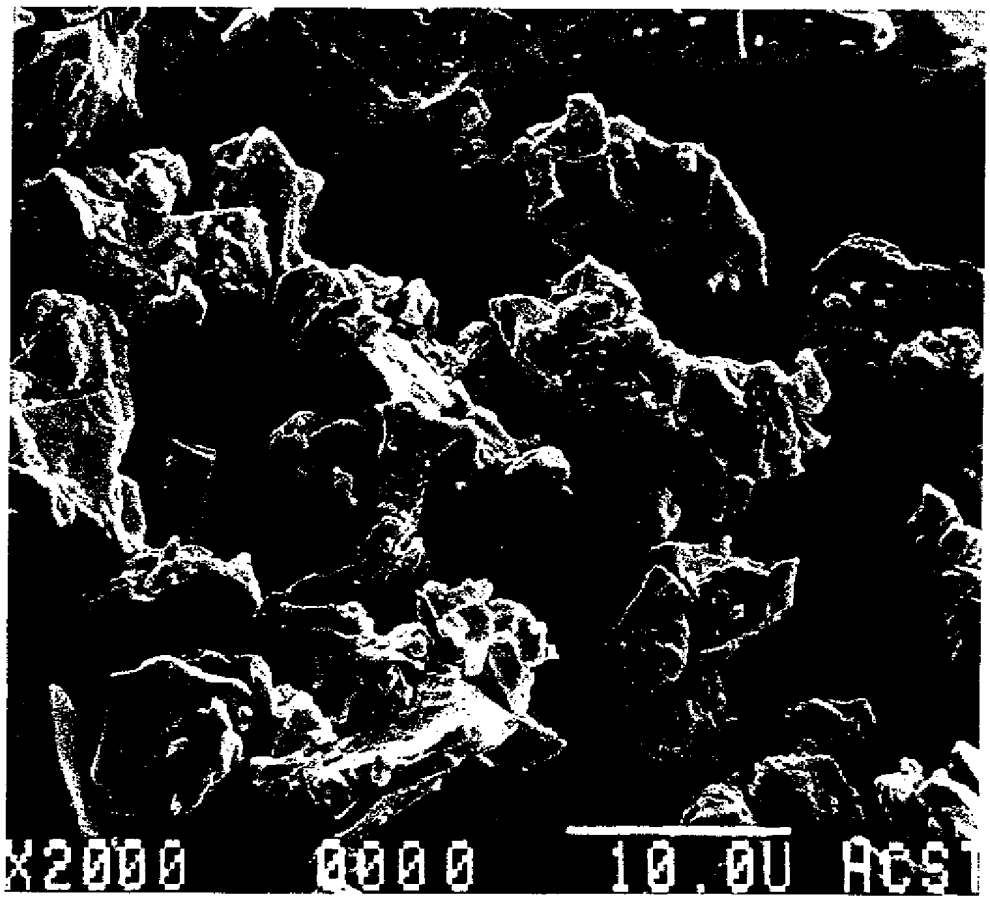
g/in³ : 60 –75
g/cm³: 3,6–4,6

Fisher Sub-Sieve Size (according to ASTM: B 330–82)

µm : 4–9

Screen Distribution (according to ASTM: B 214–76, E 11)

+200 mesh	–200–325 mesh	–325 mesh
30–55%	3–10%	40–60%



690-S *Scanning electron micrograph*

Tantalum Powder Capacitor Grade
Grade 900-HC

900-HC

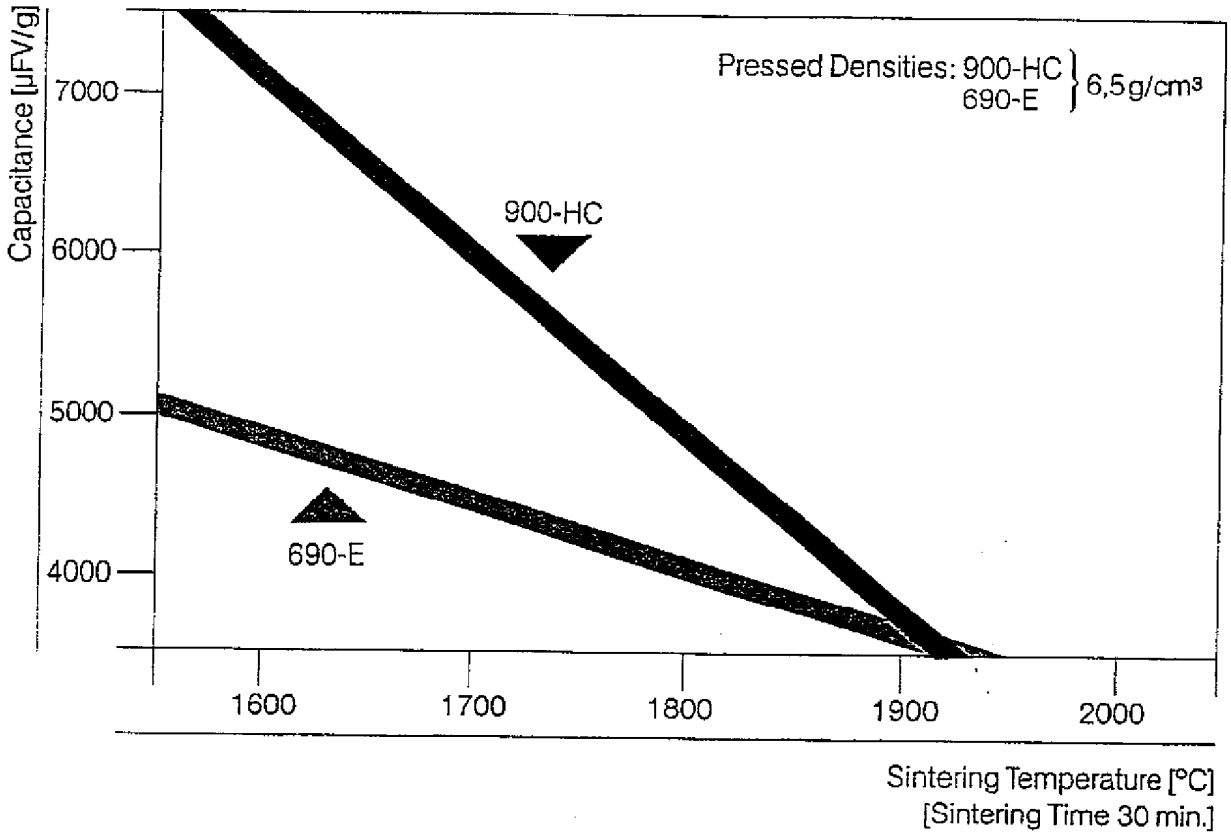
900-HC represents a new class of EB-melted high capacitance powders. The capacitance increase compared to grade 690-E is about 25% at 1700°C sintering temperature.

The application of 900-HC is in the high working voltage area.

Recommended conditions for processing

Sintering temperature:	1600–1850°C
Sintering time:	20–40 minutes
Pressed density:	6,5–7,5 g/cm³
	can be pressed without binder
Yield of capacitance:	4500–7000 µFV/g
Working voltage:	35 V and over

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
900-HC	6100	50000	1700	210	0,4
900-HC	4900	44000	1800	225	0,3

Anode weight: 1,0 g, Pressed density: 6,5 g/cm³
Sintering time: 30 min, Formation voltage: 200 V

900-HC

Typical Chemical Analysis

Elements	H	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	10	50	2000	40	35	35	10	5	10	10

Typical Physical Characteristics

Scott Density (according to ASTM: B 329–76)

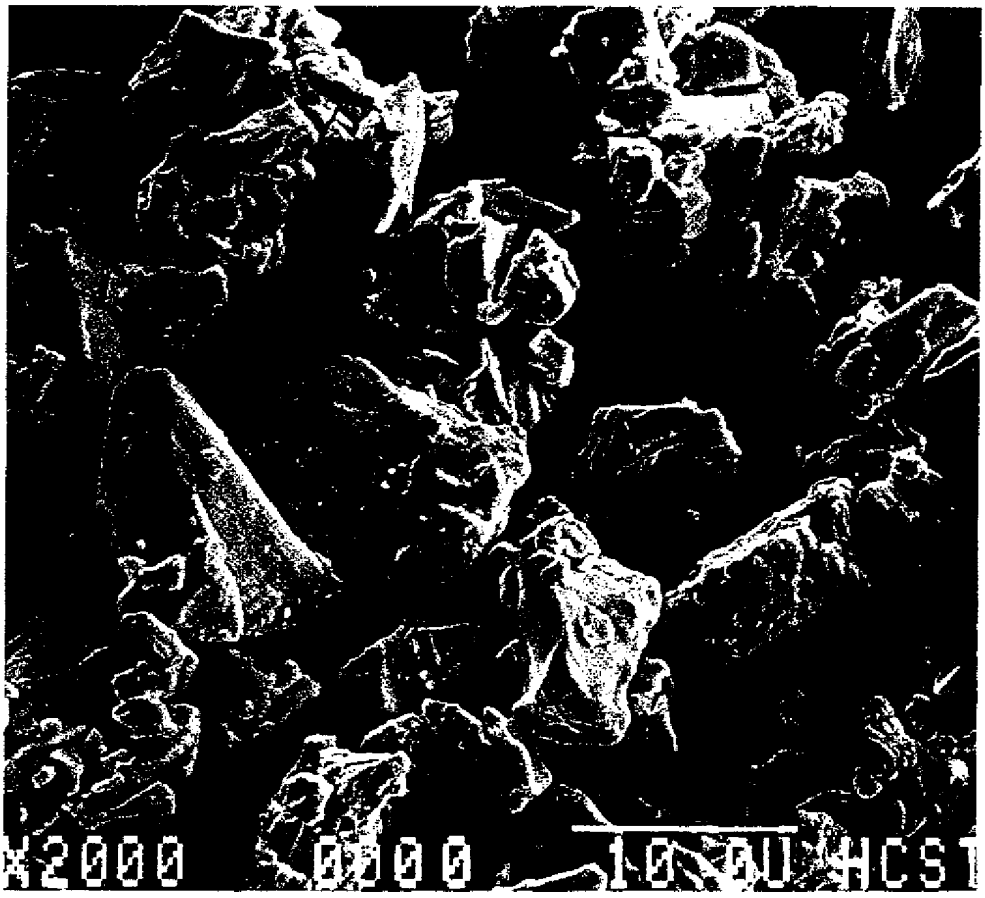
g/in³ : 55 –70
g/cm³: 3,3–4,3

Fisher Sub-Sieve Size (according to ASTM: B 330–82)

µm : 4–7

Screen Distribution (according to ASTM: B 214–76, E 11)

–40 mesh	–325 mesh
100%	30–50%



900 HC *Scanning electron micrograph*

Tantalum Powder Capacitor Grade
Special Grade

Special Grade

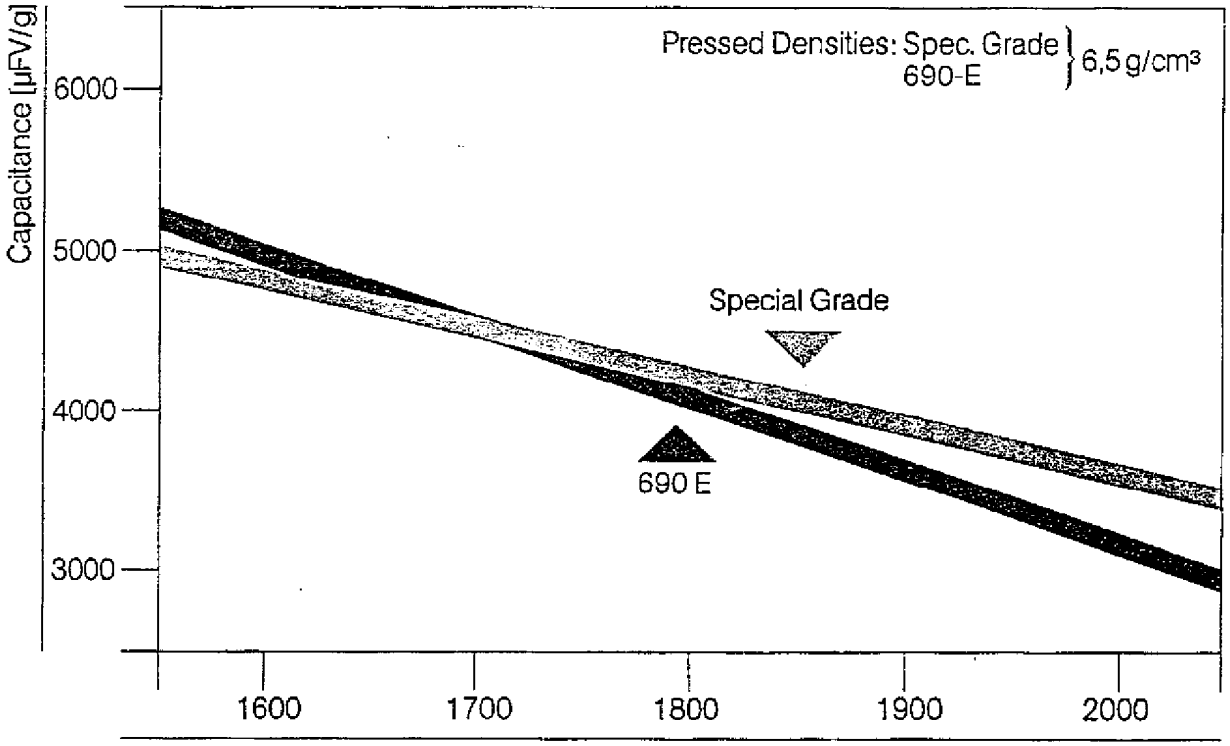
Special Grade is an EB-melted high capacitance powder with smaller temperature-capacitance-coefficient compared to grade 690-E.

The outstanding physical properties such as good flowability and high pellet green strength are almost identical to grade 690-E.

Recommended conditions for processing

Sintering temperature:	1600–1950°C
Sintering time:	15–40 minutes
Pressed density:	6,5–7,5 g/cm³
	can be pressed without binder
Yield of capacitance:	3000–5000 µFV/g
Working voltage:	35 V and over

Typical Capacitance



Typical Electrical Characteristics

Grade	µFV/g	µFV/cm³	Sintering Temperature (°C)	VBD (V)	DCL (nA/µFV)
Spec. Grade	4600	33000	1650	195	0,4
Spec. Grade	3850	32500	1850	245	0,3

Anode weight: 1,0 g, Pressed density: 7,0 g/cm³
Sintering time: 30 min. Formation voltage: 200 V

Special Grade

Typical Chemical Analysis

Elements	H	N	O	C	Fe	Nb	Si	Ti	W	Mo
ppm	10	35	1600	30	25	35	10	5	10	10

Typical Physical Characteristics

Scott Density (according to ASTM: B 329–76)

g/in³ : 60 –70
g/cm³: 3,6–4,3

Fisher Sub-Sieve Size (according to ASTM: B 330–82)

µm : 7–12

Screen Distribution (according to ASTM: B 214–76, E 11)

–40 mesh	–325 mesh
100%	30–50%

Special Grade *Scanning electron micrograph*

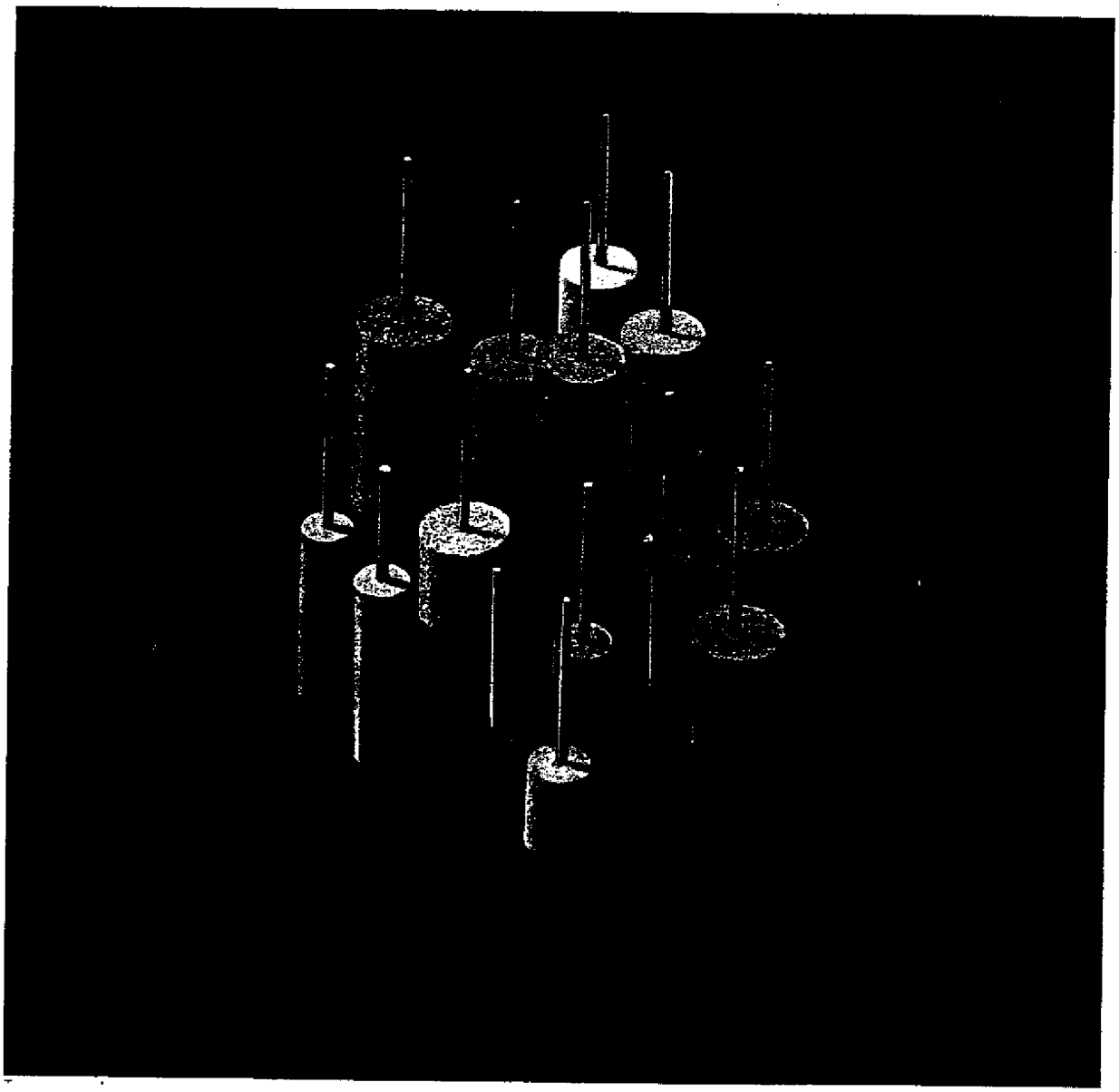
Sintered Tantalum Anodes

Hermann C. Starck Berlin have been supplying sintered anodes for wet and dry capacitors since 1969.

Years of experience in producing capacitor grade tantalum powder also enables us to produce high quality sintered anodes. The aim of our anode production is to support existing production of our customers and not to compete with our customers.

In view of the enormous variety of types, data sheets for the individual anode types are not available.
We are generally prepared to meet anode specifications within the following data.

Anode form:	cylindrical, rectangular
Anode diameter:	1,0 – 10,0 mm
Anode length:	0,5 – 20 mm
Wire diameter:	0,25 – 0,8 mm
Wire length:	10 – 22 mm (Standard figures: 10 mm, 15 mm, 20 mm)
Wire lead:	central, asymmetric
Capacitance:	0,006 – 680 µF
Formation voltage:	up to 270 V



Metallurgical Grade Powder

Tantalum Metal
Metallurgical Grade Powder

Scope: This specification covers the requirement for tantalum powder used for powder metallurgy.

Physical Analysis

Grain size:	100%–70 mesh
Scott Density:	60–100 g/inch³
(according to ASTM:	B 329–76)
Fisher Sub-Sieve Size:	6–16 µm
(according to ASTM:	B 330–76)

Chemical Analysis (max values in ppm):

H	C	N	O	AL	Si
100	200	200	2000	50	200

Cb	W	Mo	Fe	Cr	Ni
200	200	200	200	50	50

Powder out of this grade can be used for tantalum mill products.

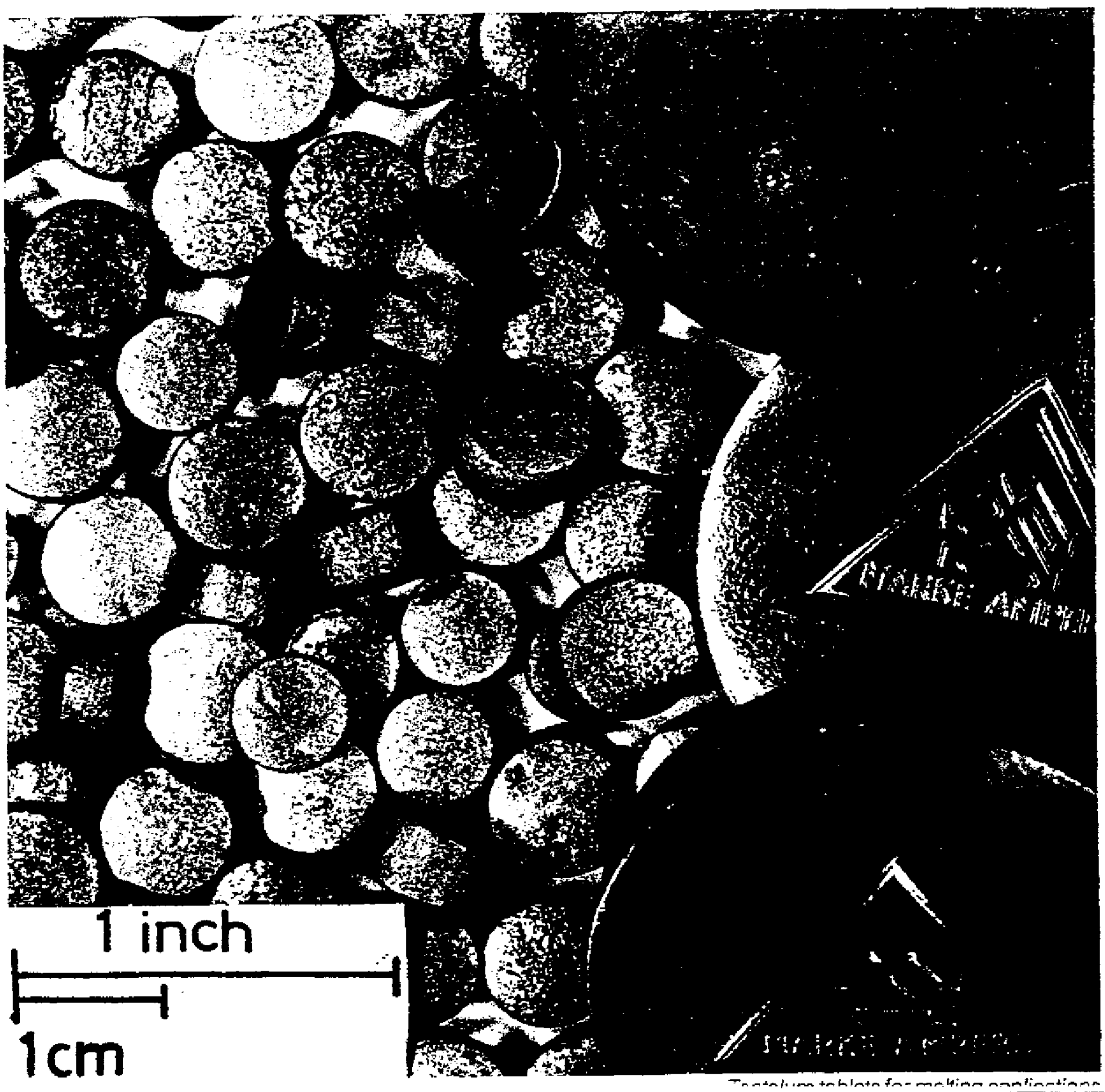
Especially in case of wire used in leads for tantalum capacitors and component parts, properties like resistance to grain growth during high temperature sintering and low leakage current are required.

There are two starting materials commonly used for mill products: electron beam-/arc-melted ingots or pressed and sintered powder bars.

In case powder is used the powder has to bear all the characteristics of the final product.

Metallurgical grade powder by ***HCST*** is recommended for this purpose.

Regarding the specification we are prepared to meet customers' requirements.



Tantalum tablets for melting applications

Metallurgical Grade Compacts

Tantalum Metal
Metallurgical Grade Compacts

Scope: This specification covers the requirement for tantalum to produce high-quality alloys by vacuum melting.

I. High Purity Grade – min. 99,8% Ta

H	C	N	O	Al	Si	S	Ti
10	300	150	600	50	100	20	30

Fe	Se	Cb	Ag	Sn	Sb	Te	Pb	Bi
150	10	200	10	10	5	10	10	5

II. Special Grade – min. 99,7% Ta

H	C	N	O	Al	Si	S	Ti
10	500	300	1500	50	200	20	30

Fe	Se	Cb	Ag	Sn	Sb	Te	Pb	Bi
150	10	200	10	10	5	10	10	5

Size

High purity grade (99,8% Ta) and
Special grade (99,7% Ta) are available in tablets

Dimensions for Tablets

Diameter 5–10 mm (0,2"–0,4")
Length 5–10 mm (0,2"–0,4")

Diameter 40 mm (1,57")
Length 10–15 mm (0,4"–0,6")

Packaging
The standard package is
100 lbs per drum

Graphic Design:
Sabine Vennekamp BDG, Bonn
Typesetting:
Böninghausen GmbH, Köln
Lithographies:
repro acht GmbH, Köln
Printed:

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